

Amendments to the Claims:

The following listing of claims replaces all prior versions, and listings, of claims in the application:

Listing of Claims:

Claim 1 (Currently amended): A process for the removal and causticisation of sodium oxalate and/or sodium sulphate from a Bayer process liquor containing sodium carbonate and one or both of sodium oxalate and sodium sulphate in an alumina refinery, the process comprising the steps of:

removing aluminate ions from the Bayer liquor through the formation of a carbonate-bearing hydrocalumite and/or sulphate-bearing hydrocalumite; and,

treating the liquor with sufficient lime to remove and causticise any residual carbonate ions and ~~some or all of the~~ any oxalate ions present whereby any reacted lime solids thus formed can be separated and safely disposed of.

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Claim 2 (Original): A process for the removal and causticisation of sodium oxalate and/or sodium sulphate as defined in claim 1, wherein the process comprises a further step, prior to said step of removing aluminate ions, in which the liquor is enriched with sulphate and/or oxalate such that any aluminate and/or carbonate ions entering with the sulphate and/or oxalate are also removed.

Claim 3 (Original): A process for the removal and causticisation of sodium oxalate and/or sodium sulphate as defined in claim 1, wherein the process comprises a further step, following said step of removing aluminate ions, of separating the carbonate-bearing hydrocalumite species and/or sulphate-bearing hydrocalumite species from the Bayer liquor to form a clarified liquor.

Claim 4 (Original): A process for the removal and causticisation of sodium oxalate and/or sodium sulphate as defined in claim 3, wherein the process comprises the further step of re-using said hydrocalumite species in an external causticisation process, whereby the aluminate contained within the hydrocalumite species is recovered.

Claim 5 (Original): A process for the removal and causticisation of sodium oxalate and/or sodium sulphate as defined in claim 1, wherein the process further comprises a pre-causticisation step in which the Bayer liquor is first causticised to reduce the concentration of carbonate ions, prior to said step of removing aluminate ions.

Claim 6 (Original): A process for the removal and causticisation of sodium oxalate and/or sodium sulphate as defined in claim 5, wherein said pre-causticisation step includes heating the liquor to close to boiling point, adding sufficient lime to react with the carbonate ions to produce substantially calcium carbonate and separating the reacted lime solids from the liquor.

Claim 7 (Original): A process for the removal and causticisation of sodium oxalate and/or sodium sulphate as defined in claim 6, wherein the heated liquor is enriched with sulphate and/or oxalate prior to pre-causticisation to ensure that any carbonate ions entering with the sulphate and/or oxalate are also causticised.


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Claim 8 (Original): A process for the removal and causticisation of sodium oxalate and/or sodium sulphate as defined in claim 1, wherein the S concentration of the Bayer process liquor prior to the said step of removing aluminate ions is between 0 and 250 g/L, and the liquor is maintained at a temperature of between 20°C and 90°C, with a reaction time of up to 120 minutes.

Claim 9 (Original): A process for the removal and causticisation of sodium oxalate and/or sodium sulphate as defined in claim 8, wherein the S concentration of the Bayer process liquor prior to the said step of removing aluminate ions is less than 150 g/L, and the liquor is maintained at a temperature of between 50°C and 70°C, with a reaction time of approximately 30 minutes.

Claim 10 (Currently amended): A process for the removal and causticisation of sodium oxalate and/or sodium sulphate as defined in claim 9 3, wherein said step of treating the clarified liquor with sufficient lime is conducted at a temperature between 20°C and 140°C, with a reaction time of between 0.25 to 4.0 hours.

Claim 11 (Original): A process for the removal and causticisation of sodium oxalate and/or sodium sulphate as defined in claim 10, wherein said step of treating the clarified liquor with sufficient lime is conducted at a temperature between 50°C and 80°C, with a reaction time of between 0.5 to 1.0 hours.


Claim 12 (Original): A process for the removal and causticisation of sodium oxalate and/or sodium sulphate as defined in claim 11, wherein the said step of treating the liquor with sufficient lime is followed by a step of separating the reacted lime solids from the liquor and disposing of the solids or washing and drying the solids for calcination and re-use.

 Claim 13 (Original): A process for the removal and causticisation of sodium oxalate and/or sodium sulphate as defined in claim 7, wherein the S concentration of the Bayer process liquor prior to said pre-causticisation step is between 0 and 250 g/L, and during said pre-causticisation step the liquor is heated to approximately 100°C.

Claim 14 (Currently amended): A process for the removal and causticisation of sodium oxalate and/or sodium sulphate as defined in claim ~~13~~ 3, wherein the process further comprises the step of preheating the Bayer process liquor to approximately 100°C prior to the step of removing the aluminate ions and the clarified liquor is cooled to between 30°C and 90°C prior to said step of removing the aluminate ions.

Claims 15-20 (Canceled).

Claim 21 (New): A process for the removal and causticisation of sodium oxalate and/or sodium sulphate from a Bayer process liquor containing carbonate ions and oxalate and/or sulphate ions, the process comprising the steps of:

-  (a) treating the Bayer process liquor to remove carbonate ions by forming carbonate-bearing solids;
- (b) separating the carbonate-bearing solids to form a clarified liquor containing residual carbonate ions and oxalate and/or sulphate ions;

- (c) adding lime to the clarified liquor to remove the residual carbonate ions and form reacted lime solids including the oxalate and/or sulphate ions; and,
- (d) separating the reacted lime solids to form a purified liquor.

Claim 22 (New): A process as defined in claim 21 wherein the carbonate-bearing solids include carbonate-bearing hydrocalumite and, after step (b), the process comprises a further step of recovering the separated carbonate-bearing hydrocalumite.

Claim 23 (New): A process as defined in claim 21, wherein step (a) further comprises the step of adding lime.

Claim 24 (New): A process as defined in claim 21, further comprising the step of enriching the Bayer process liquor with sulphate ions and/or oxalate ions.

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Claim 25 (New): A process as defined in claim 24, wherein the step of enriching is conducted prior to and/or during step (a).

Claim 26 (New): A process as defined in claim 24, wherein the step of enriching is conducted prior to and/or during step (c).

Claim 27 (New): A process as defined in claim 21, wherein the Bayer process liquor has an 'S' concentration prior to step (a) of between 0 and 250 g/L.

Claim 28 (New): A process as defined in claim 27, wherein the S concentration is less than 150 g/L.

Claim 29 (New): A process as defined in claim 21, further comprising the step of maintaining the temperature of the Bayer process liquor in step (a) between 20°C and 180°C.

Claim 30 (New): A process as defined in claim 29, wherein the temperature of the Bayer process liquor in step (a) is maintained between 20°C and the atmospheric boiling point of the Bayer liquor.

Claim 31 (New): A process as defined in claim 30, wherein the temperature of the Bayer process liquor in step (a) is maintained between 20°C and 90°C.

Claim 32 (New): A process as defined in claim 31, wherein the temperature of the Bayer process liquor in step (a) is maintained between 50°C and 70°C.

Claim 33 (New): A process as defined in claim 21, wherein step (c) is conducted at a temperature between 20°C and 140°C.

Claim 34 (New): A process as defined in claim 33, wherein step (c) is conducted at a temperature between 50°C and 80°C.

Claim 35 (New): A process as defined in claim 21, wherein step (c) is conducted over a residence time of between 15 minutes and 4 hours.

Claim 36 (New): A process as defined in claim 35, wherein step (c) is conducted over a residence time of between 30 and 120 minutes.

Claim 37 (New): A process as defined in claim 36, wherein step (c) is conducted over a residence time of between 30 and 60 minutes.

Claim 38 (New): A process as defined in claim 21, further comprising the step of washing and drying the separated reacted lime solids.

Claim 39 (New): A process as defined in claim 22, wherein the Bayer liquor includes sulphate ions and the separated reacted lime solids include sulphate-bearing hydrocalumite.

Claim 40 (New): A process as defined in claim 39, further comprising the step of recovering the sulphate-bearing hydrocalumite after step (d).

Claim 41 (New): A process as defined in claim 21, wherein the carbonate-bearing solids include calcium carbonate.

Claim 42 (New): A process as defined in claim 29, further comprising the step of cooling the heated clarified liquor prior to step (c).

Claim 43 (New): A process as defined in claim 42, wherein the step of cooling the heated clarified liquor is conducted after step (b).

Claim 44 (New): A process as defined in claim 29, wherein the heated clarified liquor is cooled to a temperature between 30°C and 90°C.

Claim 45 (New): A process as defined in claim 42, wherein the heated clarified liquor is cooled to a temperature between 30°C and 90°C after step (b).

Claim 46 (New): A process as defined in claim 44, wherein the heated clarified liquor is cooled to a temperature between 50°C and 70°C.

Claim 47 (New): A process as defined in claim 45, wherein the heated clarified liquor is cooled to a temperature between 50°C and 70°C after step (b).

Claim 48 (New): A process as defined in claim 30, further comprising the step of cooling the heated clarified liquor prior to step (c).

Claim 49 (New): A process as defined in claim 48, wherein the step of cooling the heated clarified liquor is conducted after step (b).

Claim 50 (New): A process as defined in claim 30, wherein the heated clarified liquor is cooled to a temperature between 30°C and 90°C.

Claim 51 (New): A process as defined in claim 50, wherein the heated clarified liquor is cooled to a temperature between 30°C and 90°C after step (b).

Claim 52 (New): A process as defined in claim 21, further comprising the step of agitating the Bayer liquor during step (a) and/or step (c).

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Claim 53 (New): A process as defined in claim 40, further comprising the step of recycling the recovered carbonate-bearing hydrocalumite and/or sulphate-bearing hydrocalumite within an alumina refinery.

Claim 54 (New): A process as defined in claim 40, further comprising the step of recycling the recovered sulphate-bearing hydrocalumite to step (a).
